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Gravitational SIMPs

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We study the impact of thermalization and number-changing processes in the dark sector on the yield of gravitationally produced dark matter (DM). We take into account the DM production through the s -channel exchange of a massless graviton both from the scattering of inflatons during the reheating era, and from the Standard Model bath via the UV freeze-in mechanism. By considering the DM to be a scalar, a fermion, and a vector boson we show, in a model-independent way, that DM self-interaction gives rise to a larger viable parameter space by allowing lower reheating temperature to be compatible with Planck observed relic abundance. As an example, we also discuss our findings in the context of the \mathbb{Z}_2 -symmetric scalar singlet DM model.

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